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WINTER CONDITION OF LENTICELS.

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ON THE twigs and younger branches of most woody dicotyls there are scattered over the smooth epidermis rough, corky places known as lenticels. A microscopic examination reveals the fact that the tissue just beneath the surface of the lenticel is of a porous nature, the cells being loosely fitted together and separated by large intercellular spaces. Lenticels are developed from stomata, the openings for interchange of gases which occur not only on leaves, but also on young, tender stems. The porous tissue filling the lenticel is produced by the multiplication of cells in either the phellogen or the ground tissue just beneath the stoma.

The origin and structure of lenticels lead to the belief that they are intended as passages for the circulation of gases. And since they are commonly on parts no longer green, it is generally agreed that their main function is in respiration. The large intercellular spaces found between the corky cells of the lenticel, and often between the cells in the portion of the collenchyma or parenchyma which is just beneath them, admit air to the inner tissues of the plant; and since there are smaller spaces in nearly all the tissues, the cells of the plant individually have access to atmospheric oxygen.

In Gregory's Elements of Plant Anatomy is found the following statement: "At the close of summer, when the time for winter rest draws near, the lenticel is usually closed by the last layers of the phellogen growth; that is, these layers remain a continuous collection of cells and their walls become suberized. In the spring-time the phellogen renews its activity, and the new cells, pushing up as before, break these layers apart and the opening is established anew."

To ascertain the extent to which lenticels are closed I conducted a series of experiments at the University of Kansas in the fall and winter of 1907–'08. My apparatus consisted of a J-shaped glass tube with the tip of the short arm bent outward from the long arm. The out end of the twig experimented upon was attached to the short arm by means of a short rubber connection, which was wrapped with wire around both the glass tube and the twig to make it air-tight. The short arm and twig were immersed in a vessel of water and mercury was poured into the long arm through a funnel at its upper end. The pressure of the mercury compresses the air in the short arm, forcing it through the twig and causing it to appear as bubbles wherever there are openings in the twig. The more minute the openings the greater the pressure required to produce bubbles at a visible rate. It is indeed true that when bubbles are obtained at a greater pressure they can also be obtained, more slowly, however, at lesser ones. So it is an exceedingly difficult matter to obtain an accurate comparison between different subjects, but my data enabled me to group them roughly into four classes. Class A consists of those in which the passage of air is least obstructed, so that bubbles were readily obtained with a pressure of 10 cm. or less of mercury. Class B comprises those in which 10 to 50 cm. was used to form the bubbles; class C those in which they were noticed at higher pressures (50 to 140 cm.), and class D those in which none were obtained by the highest pressures applied, which varied in different cases from 90 to 140 cm. and was generally maintained for a considerable length of time.

One hundred twigs belonging to thirty-five different species were tested between October and January, after the season's growth had ended and mostly after the leaves had fallen. The results were as follows, a number in parentheses following each species in which the same result was obtained from more than one twig.

Class A.—Salix alba, Hicoria ovata, Gymnocladus canadensis, Rhus copallina (2), Æsculus arguta, Acer saccharinum, Acer saccharum (2), Asimina triloba (2). Eleven twigs of eight species.

Class B.—Salix alba, Populus deltoides, Quercus acuminata, Corylus americana, Tuglans nigra, Hicoria ovata, Ulmus fulva (2), Ulmus americana, Celtis occidentalis (3), Plantanus occidentalis, Fraxinus lanceolata, Sambucus canadensis (2), Prunus americana (3), Gleditsia triacanthos, Gymnocladus canadensis, Amorpha fruticosa, Rhus aromatica, Ailanthus glandulosus, Acer negundo. Twenty-six twigs of nineteen species.

Class C.—Juniperus virginiana, Populus deltoides, Juglans nigra, Ulmus americana, Celtis occidentalis (2), Toxylon pomiferum (2), Plantanus occidentalis, Catalpa speciosa, sanbucus canadensis, Prunus cerevisieæ, Gleditsia triacanthos, Gymnocladus canadensis (3), Cercis canadensis, Rhus glabra (3), Xanthoxylum americanum (3), Acer saccharinum (2), Acer negundo (3). Twenty-eight twigs and seventeen species.

Class D.—Juglans nigra, Ulmus americana, Catalpa speciosa, Cornus asperifolia, Prunus americana, Prunus persica, Pyrus coronaria, Gleditsia triacanthos (3), Cercis canadensis (2), Rhus copallina, Ailanthus glandulosus, Acer saccharinum (8), Acer negundo (11), Tilia americana, Asimina triloba. Thirty-five twigs and fifteen species.

Sixty-five of the twigs tested seemed to have some or all of their lenticels open for respiration during the winter months, while the other thirty-five did not have such provision. In about half of the former cases, however, bubbles were seen from one-half or fewer of the lenticels immersed, in some instances from but a small percentage of them.

It was noticed that the two-year-old growth has generally more open lenticels than the growth of the season, and that the three-year-old growth has more than the two-year. Likewise, the older lenticels appeared to have the freest passage for air.

It was also rather remarkable that in the case of some species tested, notably the papaw, some twigs gave decidedly positive and others as decidedly negative tests. In several cases open and closed lenticels of a species were marked, imbedded in paraffin, and sectioned. No difference could be detected with the microscope. In no case could an open intercellular passage be traced to the interior of the stem, there seemingly being just beneath the filling tissue a layer of cork without spaces such as histologists describe.

It appeared that generally the rank-growing shoots, such as the water-sprouts from the base of the tree, had the lenticels more generally closed than did the smaller or more stunted shoots.

In class D are only four species which were not placed also in one of the other classes on account of their lenticels having been in some instances found open; and of each of these four species only one twig was tested.

Lenticels were looked for on the roots of several species and were found well developed on many but not all of them. Their structure is quite similar to that of stem lenticels. I tested a few with the pressure apparatus, with the following results:

Class B.—Juglans nigra, Rhus glabra (2).

Class C.—Rhus glabra (2).

Class D.—Rhus glabra (2), Ailanthus glandulosus (2), Xanthoxylum americanum (2), Rosa sp., Sambucus canadensis.

Summary.—Four with open lenticels, eight without. In several instances root-lenticels were closed while the lenticels on the stems of the same plant were open.

Late in May and early in June, 1908, I tested the following twigs, all of which had made considerable growth:

Class A.—Ulmus americana (2).

Class B.—Populus deltoides (2), Ulmus americana, Gleditsia triacanthos (2), Ailanthus glandulosus, Acer saccharinum, Acer negundo, Asimina triloba (2). Ten twigs of seven species.

Class C.—Juglans nigra (2), Toxylon pomiferum, Gleditsia triacanthos, Cercis canadensis (2), Acer saccharinum. Seven twigs of five species.

None of the nineteen twigs examined gave entirely negative results, although in several cases bubbles were formed slowly and from only a comparatively small proportion of the lenticels. On the whole, however, lenticels seem to be open in greater numbers in the spring than in the fall. But the fact that so many of them are open in the fall and winter seems to be a point worthy of further investigation.